

Safety Function: Area Scanners – Single Zone

Products: GuardLogix Controller, SafeZone Laser Scanner
Safety Rating: CAT. 3, PLd to EN ISO 13849-1: 2008

LISTEN.
THINK.
SOLVE.[®]

Allen-Bradley • Rockwell Software

Rockwell
Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attention helps you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

General Safety Information

Contact Rockwell Automation to find out more about our safety risk assessment services.

IMPORTANT	This application example is for advanced users and assumes that you are trained and experienced in safety system requirements.
	ATTENTION: Perform a risk assessment to make sure all task and hazard combinations have been identified and addressed. The risk assessment can require additional circuitry to reduce the risk to a tolerable level. Safety circuits must take into consideration safety distance calculations, which are not part of the scope of this document.

Table of Contents

Important User Information	2
General Safety Information	3
Introduction	3
Safety Function Realization: Risk Assessment	4
SafeZone Single-zone Laser Scanner Safety Function	4
Safety Function Requirements	4
Functional Safety Description	4
Bill of Material	5
Setup and Wiring	5
Configuration	9
Programming	20
Calculation of the Performance Level.....	23
Verification and Validation Plan.....	25
Additional Resources	30

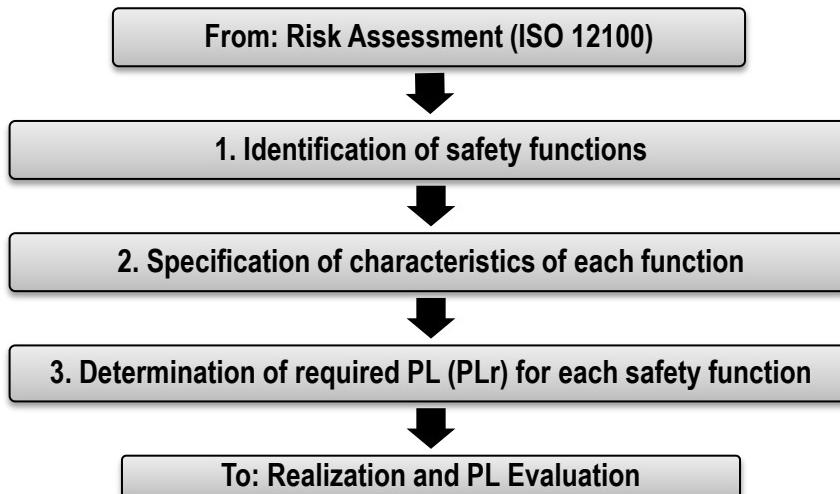
Introduction

This safety function application note explains how to wire, configure, and program a GuardLogix® controller and POINT Guard I/O™ module to monitor a SafeZone™ laser scanner control. If a demand is placed on the SafeZone laser scanner or a fault is detected in the monitoring circuit, the GuardLogix controller de-energizes the final control device, in this case, a redundant pair of 100S contactors.

This example uses a GuardLogix controller and a SafeZone laser scanner. The SISTEMA calculations shown later in this document must be re-calculated if different products are used.

Safety Function Realization: Risk Assessment

The required performance level is the result of a risk assessment and refers to the amount of the risk reduction to be carried out by the safety-related parts of the control system. Part of the risk reduction process is to determine the safety functions of the machine. In this application, the performance level required (PL_r) by the risk assessment is Category 3, Performance Level d (CAT. 3, PLd), for each safety function. A safety system that achieves CAT. 3, PLd, or higher, can be considered control reliable. Each safety product has its own rating and can be combined to create a safety function that meets or exceeds the PL_r.



SafeZone Single-zone Laser Scanner Safety Function

The safety system described in this application has one safety function: safety-related stop initiated by an intrusion into the protective area of the SafeZone safety scanner.

Safety Function Requirements

The interruption of the laser scanner stops and prevents hazardous motion by removing power to the motor by the use of two safety contactors. When the laser scanner is reset, the motor does not resume until a secondary action occurs—the Reset button is pressed and released. Faults at the laser scanner, control-wiring terminal, or safety controller are detected before the next safety demand. The safe distance location of the laser scanner control must be established such that the hazardous motion must be stopped before the user can reach the hazard. This distance is called the Safety Distance and is addressed later in this application technique.

The safety function in this application technique meets or exceeds the requirements for Category 3, Performance Level d (CAT. 3, PLd), per EN ISO 13849-1 and control reliable operation per ANSI B11.19.

Functional Safety Description

Hazardous motion is interrupted or prevented by interrupting the sensing zone of the SafeZone scanner. The 442L SafeZone scanner is wired to a pair of safety inputs of a 1734-IB8S module. The I/O module is connected, via CIP Safety, over an EtherNet/IP network to the 1768-L43S Compact GuardLogix® safety controller.

The safety code in the safety processor monitors the status of the safety input by using the pre-certified safety instruction Dual Channel Input Stop (DCS). When all safety input interlocks are satisfied, no faults are detected, and the Reset button is pressed and released, a second pre-certified function block called Configurable Redundant Output (CROUT) controls and monitors feedback for a pair of 100S redundant contactors. The 100S redundant contactors are wired to a pair of safety outputs of a 1734-OB8S module.

In summary, when the SafeZone scanner is blocked, the contactors drop out. When the SafeZone scanner is unblocked, and the Reset button is pressed and released, the contactors are energized.

Bill of Material

This application uses these products.

Cat. No.	Description	Quantity
1585J-M4TBJM-2	1585 Ethernet cables, 4 conductors, RJ45, straight male, standard, RJ45, straight male, teal robotic TPE, UL CMB, CMX, CUL, CMG, standard TIA 568-B	2
1783-US05T	Stratix 2000™ switch, unmanaged, 5 copper ports	1
1768-ENBT	EtherNet/IP bridge module	1
1768-L43S	CompactLogix™ L43 safety processor, 2.0 Mb standard memory, 0.5 Mb safety memory	1
1768-PA3	Power supply 120/240V AC input 3.5 A @ 24V DC	1
1769-ECR	Right end cap/terminator	1
1734-AENT	EtherNet/IP twisted-pair media I/O adapter	1
1734-IB8S	POINT Guard I/O safety module, 8-point input module (compatible with terminal bases with 8 terminations)	1
1734-OB8S	POINT Guard I/O safety module, 8-safety sourcing output module (compatible with terminal bases with 8 terminations)	1
1734-TBS	Module bases with removable IEC spring terminals (quantity 10)	4
1794-PS13	85...264V AC to 24V DC 1.3 A power supply	1
442L-SFZNSZ	SafeZone single-zone scan head and I/O module	1
442L-CSFZNMZ-10	10M pre-wired 13-conductor memory module	1
442L-ACRS232	2M RS-232 configuration cable	1
100S-C09ZJ23C	MCS 100S-C safety contactor, 9 A, 24V DC	2
800FM-G611MX10	800F push button - metal, guarded, blue, R, metal latch mount, 1 N.O. contact, 0 N.C. contacts, standard pack	1

Setup and Wiring

For detailed information on installing and wiring, refer to the publications listed in the [Additional Resources](#) on the back cover.

System Overview

The 1734-IB8S safety input module monitors the input from the SafeZone laser scanner control. The SafeZone laser scanner control provides two PNP outputs that are turned off when an object interrupts its field of view.

If intrusion in the SafeZone area is detected, the final control devices, a pair of 100S safety contractors (K1 and K2) are de-energized. The contactors are controlled by a 1734-OBS safety output module. These are wired in a redundant configuration and are tested on startup for faults. The start-up test is accomplished by using a Configurable Redundant Output (CROUT) instruction to monitor the feedback circuit into input 7 (I7) before the contactors are energized. These de-energized contactors remove power to the motor. The motor coasts to a stop (Stop Category 0). When the SafeZone laser scanner control resumes its normal state, these contactors are not energized until the system is reset by a momentary push button (PB1).

The system is to be designed such that no single fault results in the safety system failing to perform its safety function. A single fault is detected before the next demand on the safety system. The system cannot be reset until the fault is corrected.

The Reset buttons and the contactor feedback circuit are all wired to the 1734-IB8S module. The Reset buttons can also be wired to a standard input module.

Installation

A SafeZone laser scanner provides no physical barrier between a person and the hazardous motion. The scanner must be installed at a sufficient distance from the hazardous motion to make sure that anyone entering into the configured sensing zone cannot reach the hazard before it has stopped. This distance is referred to as the Safety Distance.

The Safety Distance (S) requirement varies from installation-to-installation and, therefore, must be calculated for each specific application. This application note uses the formula from EN ISO 13855.

The safety distance (S) depends on:

- Approach speed of the body or parts of the body
- Stopping/run-down time of the machine or system

IMPORTANT

The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.

- Response time of the SafeZone safety laser scanner
- Supplements for general measurement errors and any measurement errors related to reflection
- Supplement for prevention of reaching over
- Height of the scan plane
- Time for switching between the monitoring cases



ATTENTION: Avoid mounting retro-reflectors at a distance of less than 1 m (3.28 ft) from the boundary of the protective safety field.

With retro-reflectors positioned at a distance of less than 1 m (3.28 ft) from the boundary of the protective safety field a supplement, Z_R , of 200 mm (7.87 in.) must be added to the protective safety field.

Formula: $S = (K \times (T_M + T_S)) + Z_G + Z_R + C$

Symbol	Definition
S	Minimum distance, in millimeters (mm)
K	Parameter, in millimeters per second (mm/s), derived from data on approach speeds of the body or parts of the body
T_M	Stopping/run-down time of the machine or system
T_S	Response time of the SafeZone multizone safety laser scanner combined with the downstream controller
Z_G	General safety supplement = 100 mm
Z_R	Supplement for measurement error related to reflection There are no reflective surfaces that could affect the safety laser scanner; therefore, $Z_R = 0$.
C	Supplement for prevention of reaching over

In this example, the stopping time (T) is a summation of the following.

Input Values

SafeZone laser scanner control delay time: 60 ms (from product documentation)

1734-IB8S delay = 16 ms (from product documentation)

Input Module Connection delay¹

Safety Controller delay²

- Safety Task Watchdog
- Safety Task Period

Output Module Connection Delay³

1734-OB8S delay = 6 ms (from product documentation)

Contactor response time = 15 ms (from product documentation)

Actual Machine stop time = Assume 900 ms for this example

¹ The Input Module connection delay defaults to 4 x requested packet interval (RPI).

If we assume a RPI of 10 ms, the maximum delay = 40 ms

² The safety controller delay is a combination of the safety task period plus the safety task watchdog. The watchdog accounts for the possibility that the safety code runs right up to, but does not trip the watchdog. The safety task period accounts for the possibility that the asynchronous scan just ended when the input changed state. For this example, the following assumptions were made:

Safety Task Period = 10 ms

Safety Task Watchdog = 5 ms

Therefore, the $T_M + T_S$ in this example is 1029 ms.

³ The Output Module connection delay defaults to 3 x RPI.

If we assume a RPI of 10 ms, the maximum delay = 30 ms

The worst case reaction time can be calculated by assuming there is only a single fault in the control system. This means that only the higher of the two connection delay values shown above, needs to be included in the time calculation. For this example, 40 ms is used, and the 30 ms is excluded. To account for multiple faults occurring at the same time, use both values in the calculation.

Calculation using the formula: $S = (K \times (T_M + T_S)) + Z_G + Z_R + C$

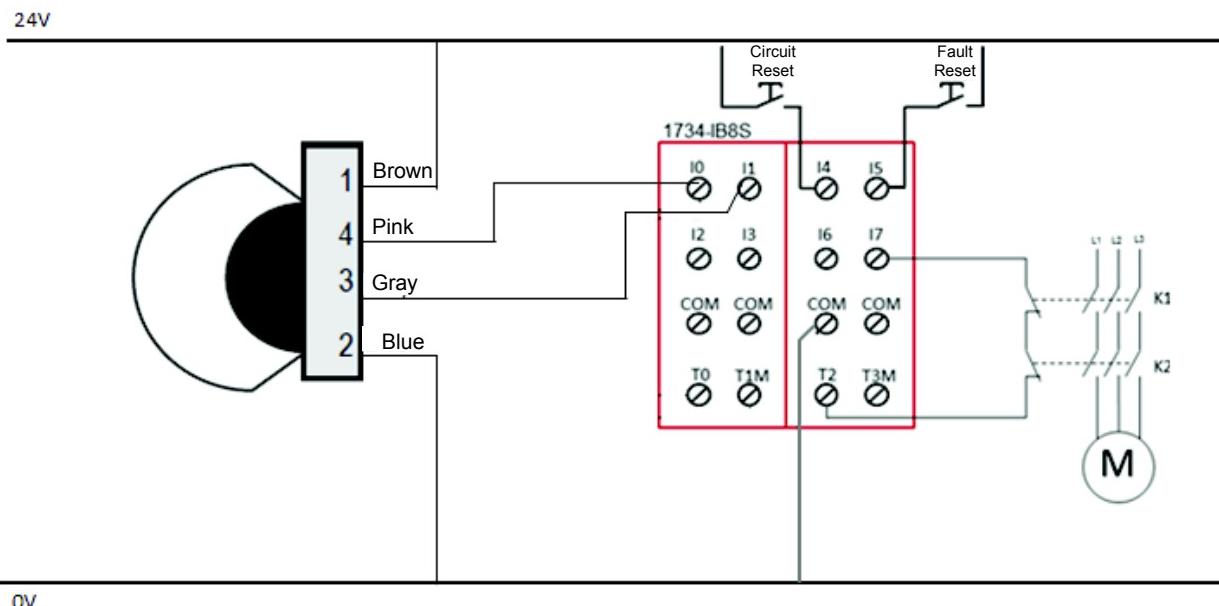
In this application technique, these are the values.

K	1600 mm/s
$T_M + T_S$	1029 ms
$Z_G + Z_R$	100 mm
C	850 mm (with reference to the Multi-beam formula)
S	$1600 \times 1.029 + 100 + 850 = 2596.4$

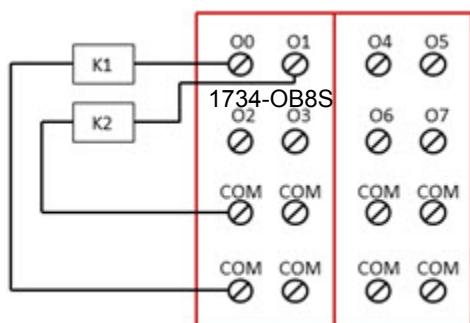
Conclusion: The SafeZone laser scanner must not be mounted closer than 2596.4 mm from the hazardous motion being guarded against.

Electrical Schematic

Input Circuit



Output Circuit



Where K1 and K2 are safety contactors.

Configuration

You need to configure the SafeZone laser scanner, the controller, and the I/O modules.

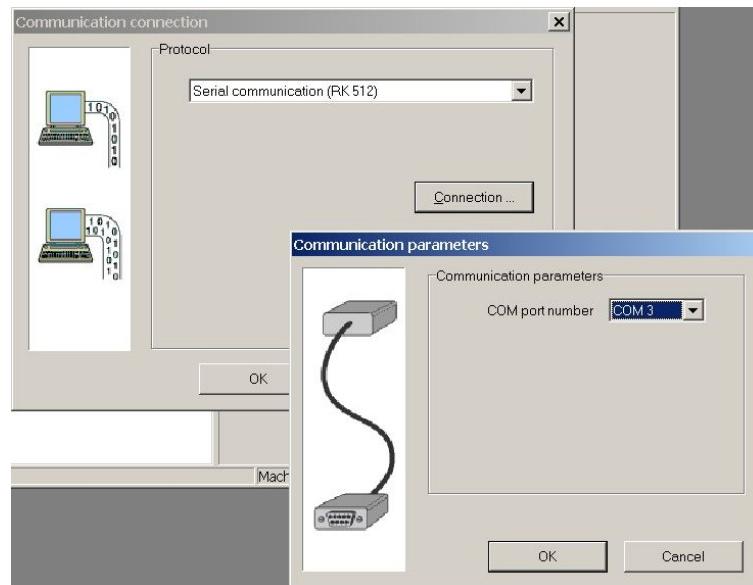
Configure the SafeZone Laser Scanner

Configure the number of zones, the safety zones, and the warning zones for the laser scanner by using Safety Configuration and Diagnostics (SCD) software.

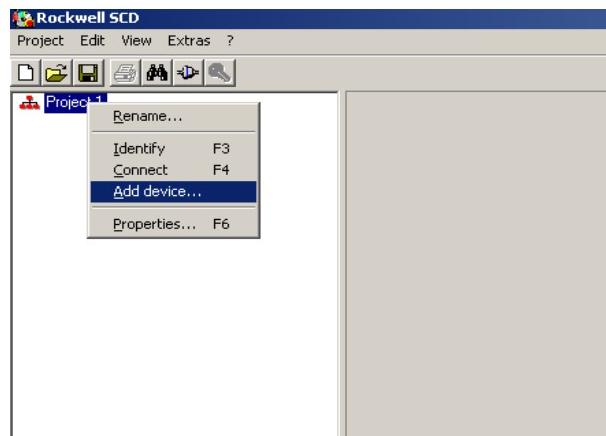
1. Launch the SCD software.
2. From the Extras menu, choose Communication connection.



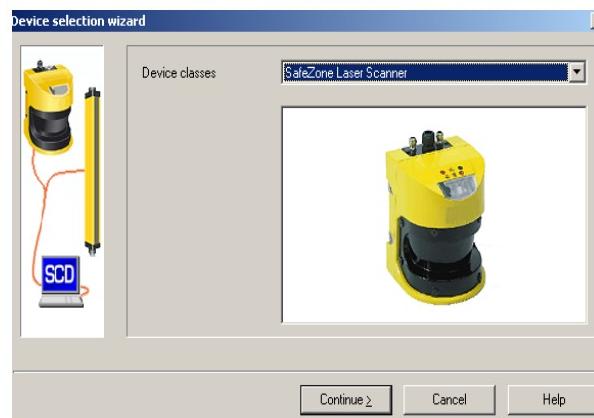
3. From the Protocol pull-down menu, choose Serial Communication RK512.
4. From the COM port number pull-down menu, choose the relevant COM port.



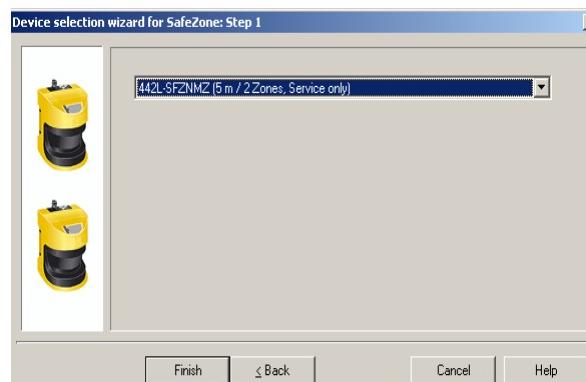
5. Create a new project, and then right-click Project and choose Add device.



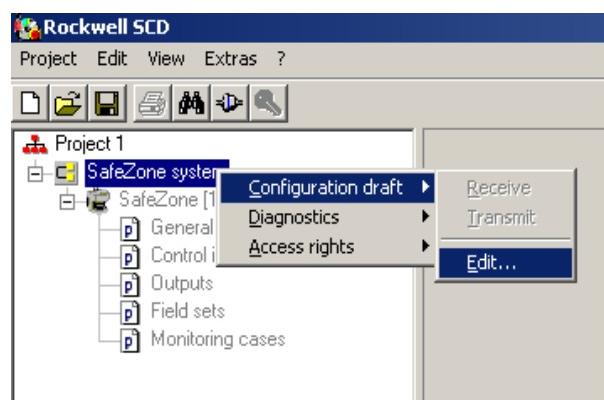
6. From the Device classes pull-down menu, choose SafeZone Laser Scanner.



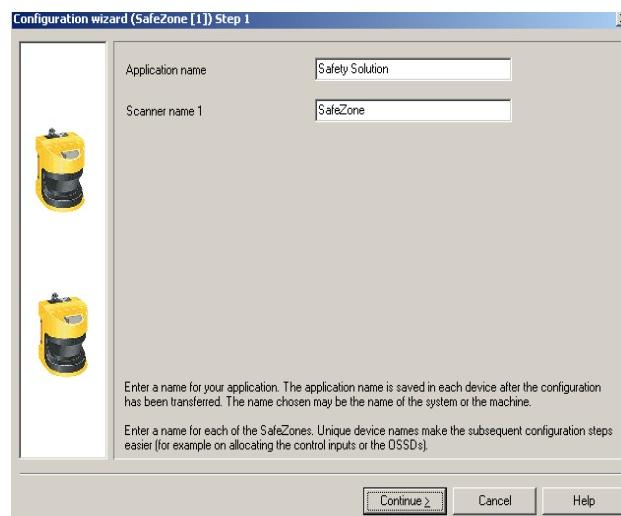
7. Choose the model number for the SafeZone laser scanner.



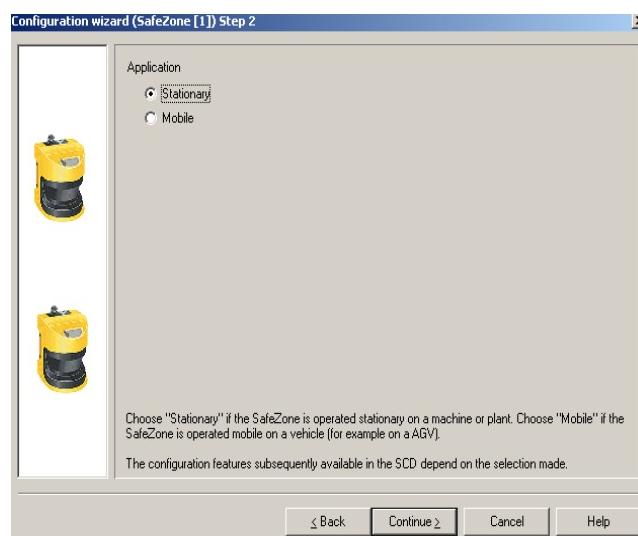
8. Right-click SafeZone systems > Configuration draft > Edit.



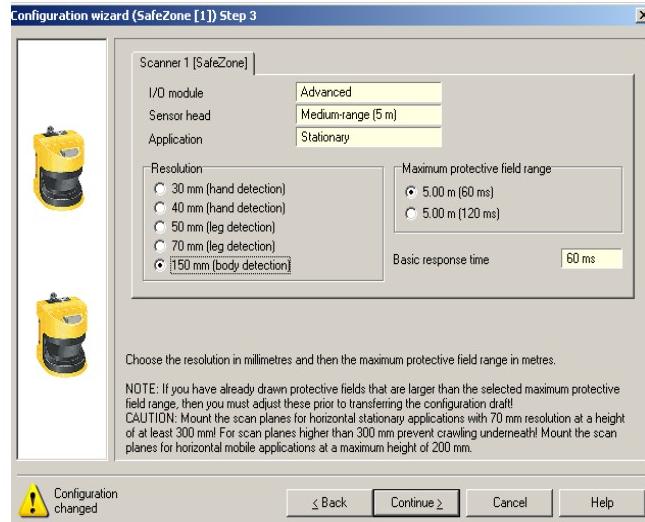
9. Type the Application name and the Scanner name 1 and then click Continue.



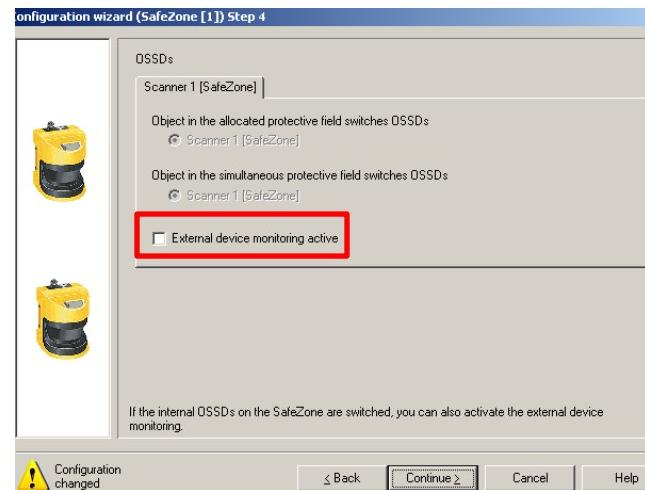
10. Under Application, click Stationary and then click Continue.



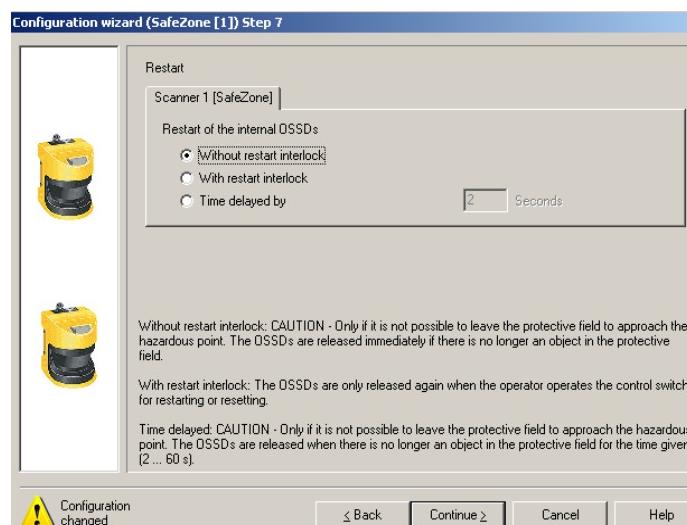
11. Under Resolution, click 150 mm (body detection) and then click Continue.



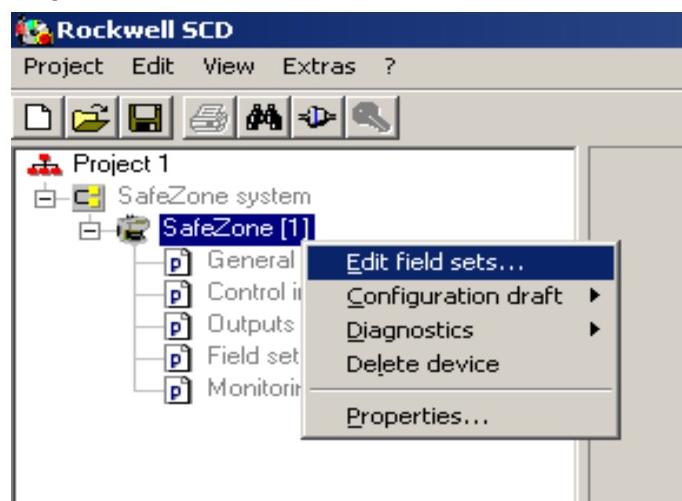
12. Verify that the External device monitoring active is cleared and then click Continue.



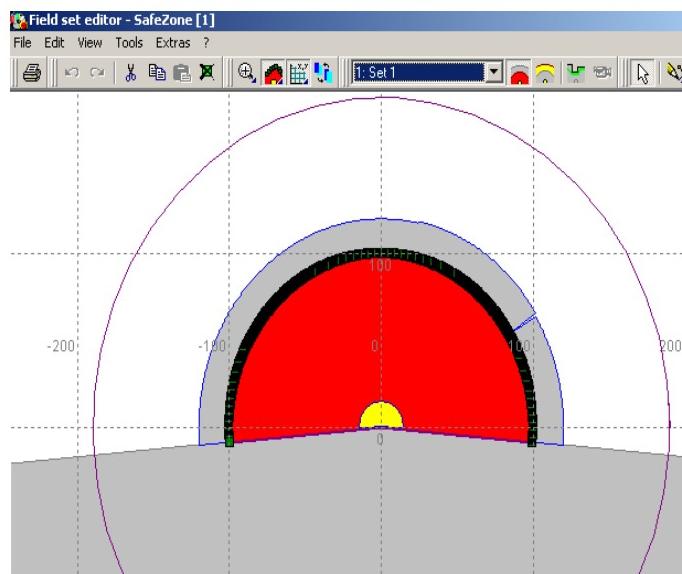
13. Under Restart, click Without restart interlock and then click Continue.



14. Right-click SafeZone and choose Edit field sets.



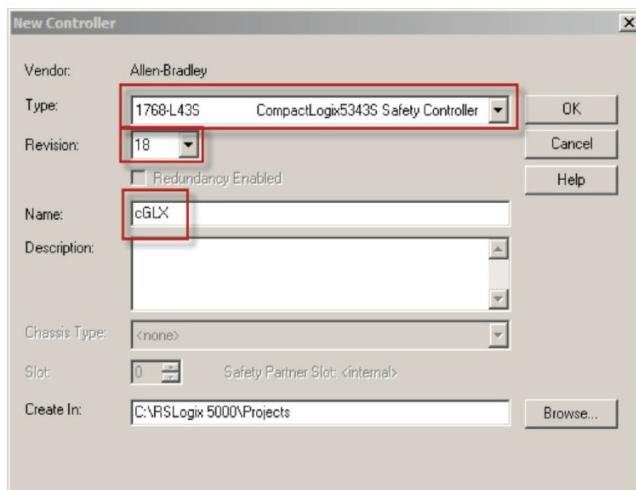
15. Draw the relevant protective area (SafeZone) and the warning area, then transmit the configuration to the SafeZone laser scanner.



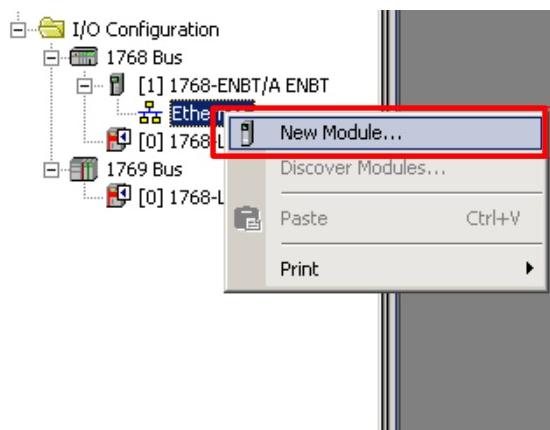
Configure the Controller and Add I/O Modules

The Compact GuardLogix controller is configured by using RSLogix™ 5000 software, version 17 or later. You must create a new project and add the I/O modules. Then, configure the I/O modules for the correct input and output types. A detailed description of each step is beyond the scope of this document. Knowledge of the RSLogix programming environment is assumed.

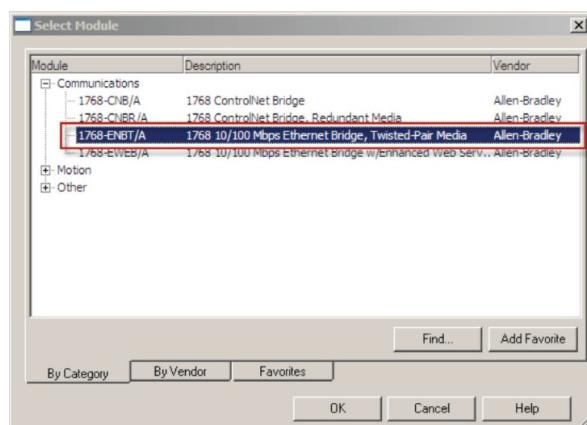
1. In RSLogix 5000 software, create a new project.
2. Choose a controller.
 - a. From the Type pull-down menu, choose 1768-L43S CompactLogix 5343S Safety Controller.
 - b. From the Revision pull-down menu, choose the appropriate revision for the controller.
 - c. In the Name box, type an appropriate name for the controller.
 - d. Click OK.



3. In the Controller Organizer, right-click 1768 Bus and choose New Module.

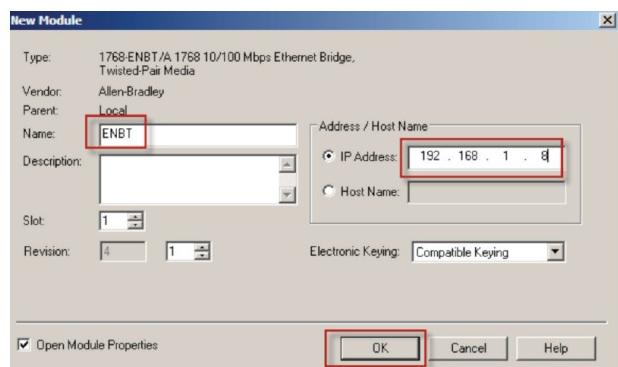


4. Choose the 1768-ENBT module and click OK.

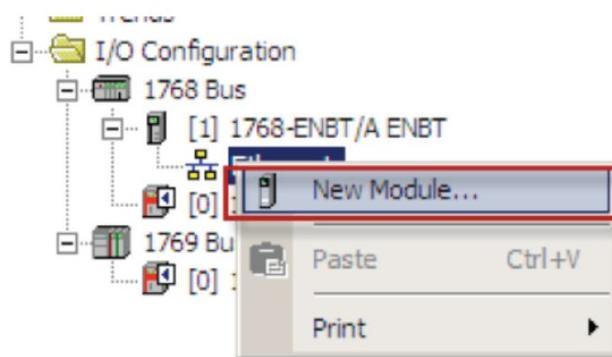


5. Name the module, type its IP address, and click OK.

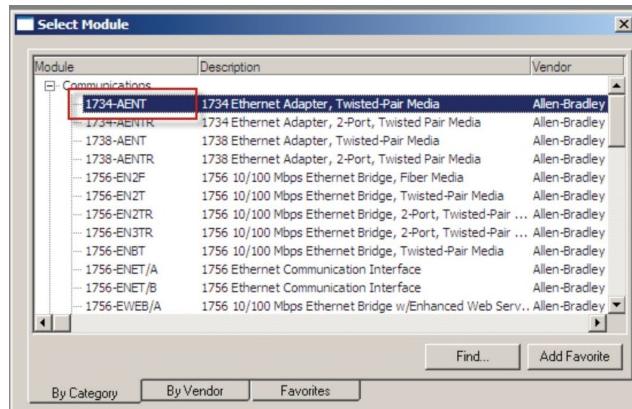
For this application example, we used 192.168.1.8; however, your IP address can be different.



6. In the Controller Organizer, right-click the 1768-ENBT module and choose New Module.

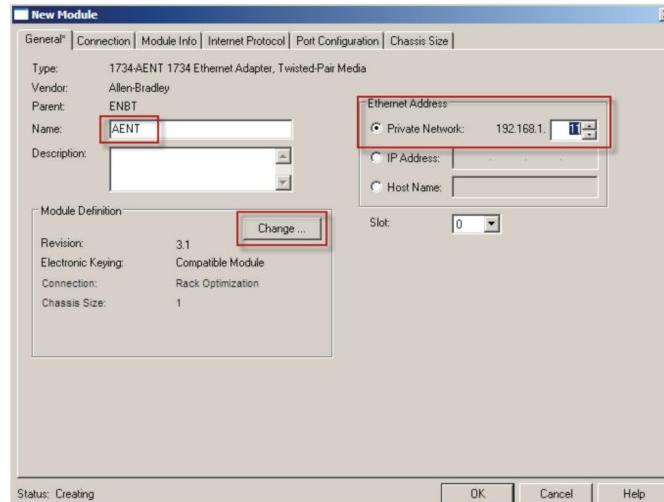


7. Select the 1734-AENT adapter and click OK.



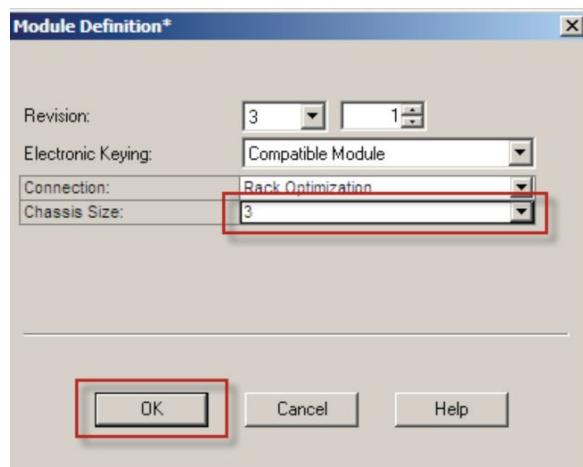
8. Name the module, type its IP address, and click OK.

For this application example, we used 192.168.1.11; however, your IP address can be different.



9. Click Change.

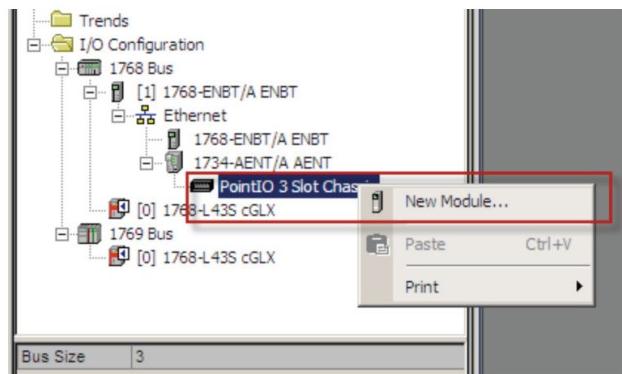
The Module Definition dialog box appears.



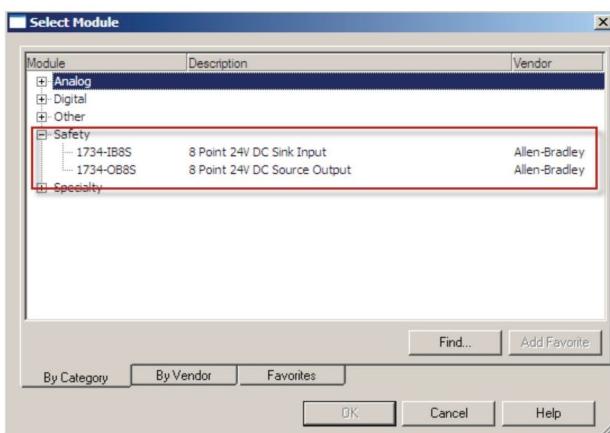
10. From the Chassis Size pull-down menu, choose 3 and click OK.

Chassis size is the number of modules that is inserted in the chassis. The 1734-AENT adapter is considered to be in slot 0; therefore, for one input and one output module, the chassis size is 3.

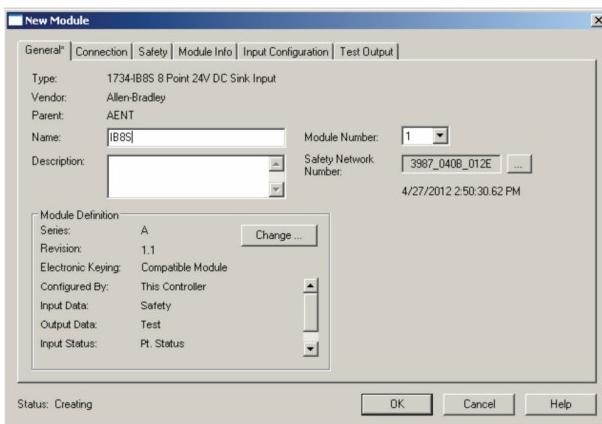
11. In the Controller Organizer, right-click the 1734-AENT adapter and choose New Module.



12. Expand Safety, select the 1734-IB8S module, and click OK.

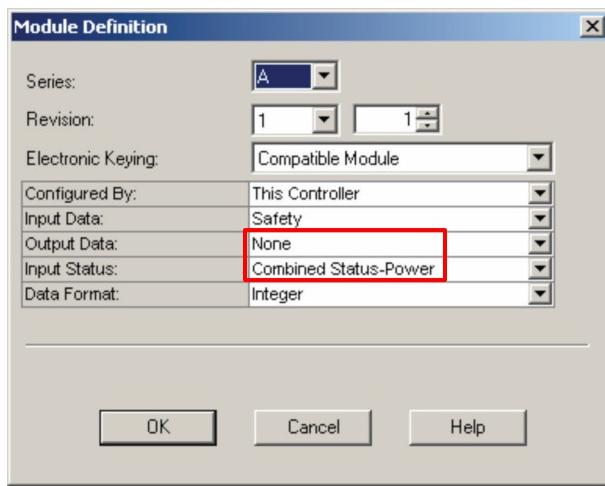


13. In the New Module dialog box, name the device IB8S, then click Change.



The Module Definition dialog box appears.

14. From the Output Data pull-down menu, choose None.
15. Verify that the Input Status is set to Combined Status-Power, and click OK.



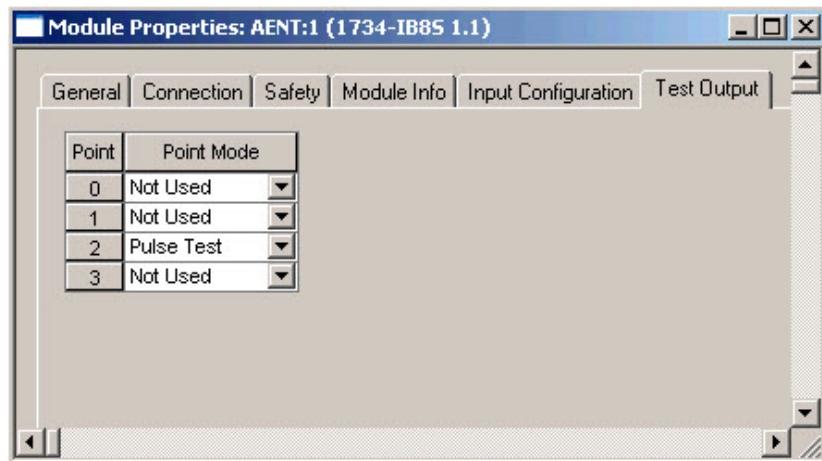
16. Repeat steps 10...14 to add the 1734-OB8S safety output module with these exceptions:

- Name the module OB8S
- Set the module to slot 2
- Set the Input Status to Combined Status-Read back-Power

Configure the I/O Modules

Follow these steps to configure the POINT Guard I/O modules.

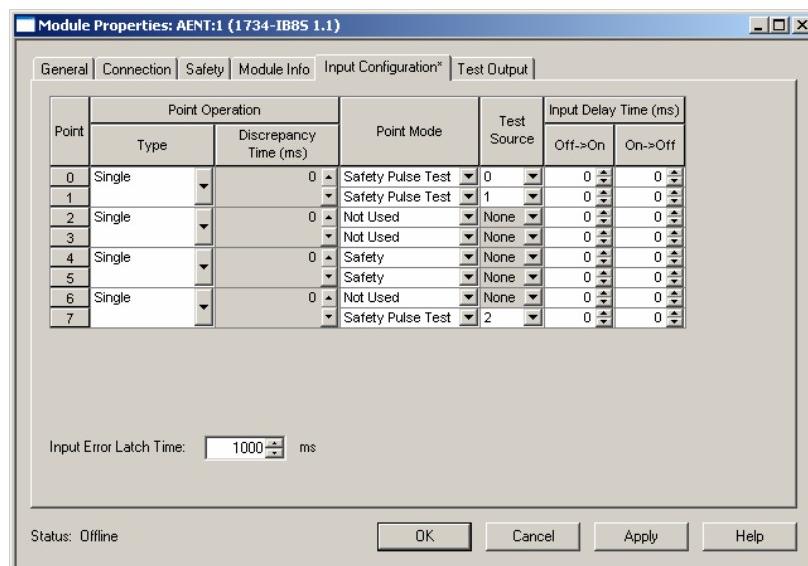
1. In the Controller Organizer, right-click the 1734-IB8S module and choose Properties.
2. Click the Test Output tab and configure the module as shown.



3. Click Input Configuration and configure the module as shown:

- Input Points 0/1 are the SafeZone laser scanners.
- Input Points 4/5 are the Reset buttons.
- Input Point 7 is the contactor monitoring circuit.

Recall that input point 7 is being sourced from Test Output 2.

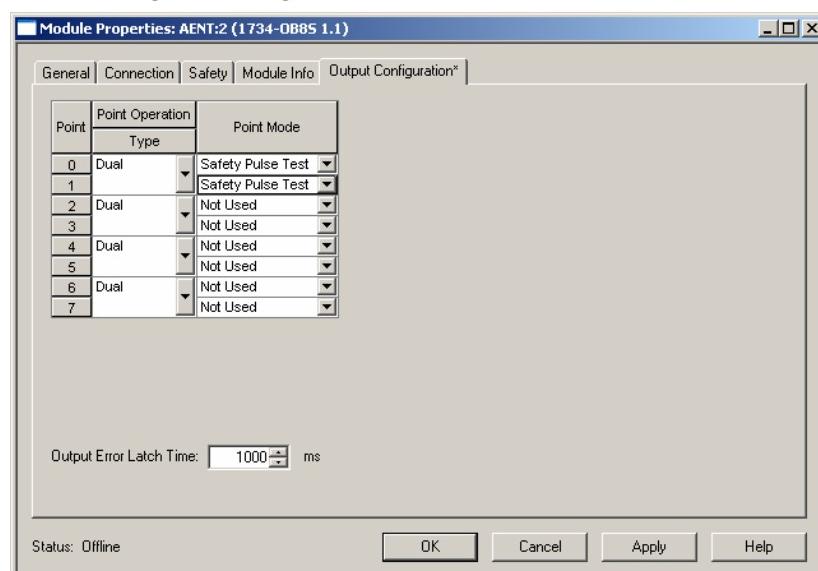


4. Click OK.

5. In the Controller Organizer, right-click the 1734-OB8S module and choose Properties.

6. Click the Output Configuration tab and configure the module as shown.

Typically, contactor coils will not react to the pulse testing of the output wires. If using a contactor that does react to the pulse test, then disable the pulse testing. This should not affect the overall safety rating if redundancy and monitoring are being utilized.



7. Click OK.

Programming

The Dual Channel Input Stop (DCS) instruction monitors dual-input safety devices whose main function is to stop a machine safely, for example, an E-stop, light curtain, or safety gate. In this example, it is being used to monitor a SafeZone laser scanner.

The DCS instruction monitors dual-input channels for consistency (Equivalent-Active High) and detects and traps faults when the inconsistency is detected for longer than the configured Discrepancy Time (ms).

The automatic restart type allows the DCS output (O1) to reset automatically after a demand. The manual action typically required for safety is provided in rung 1 to reset the safety output enable.

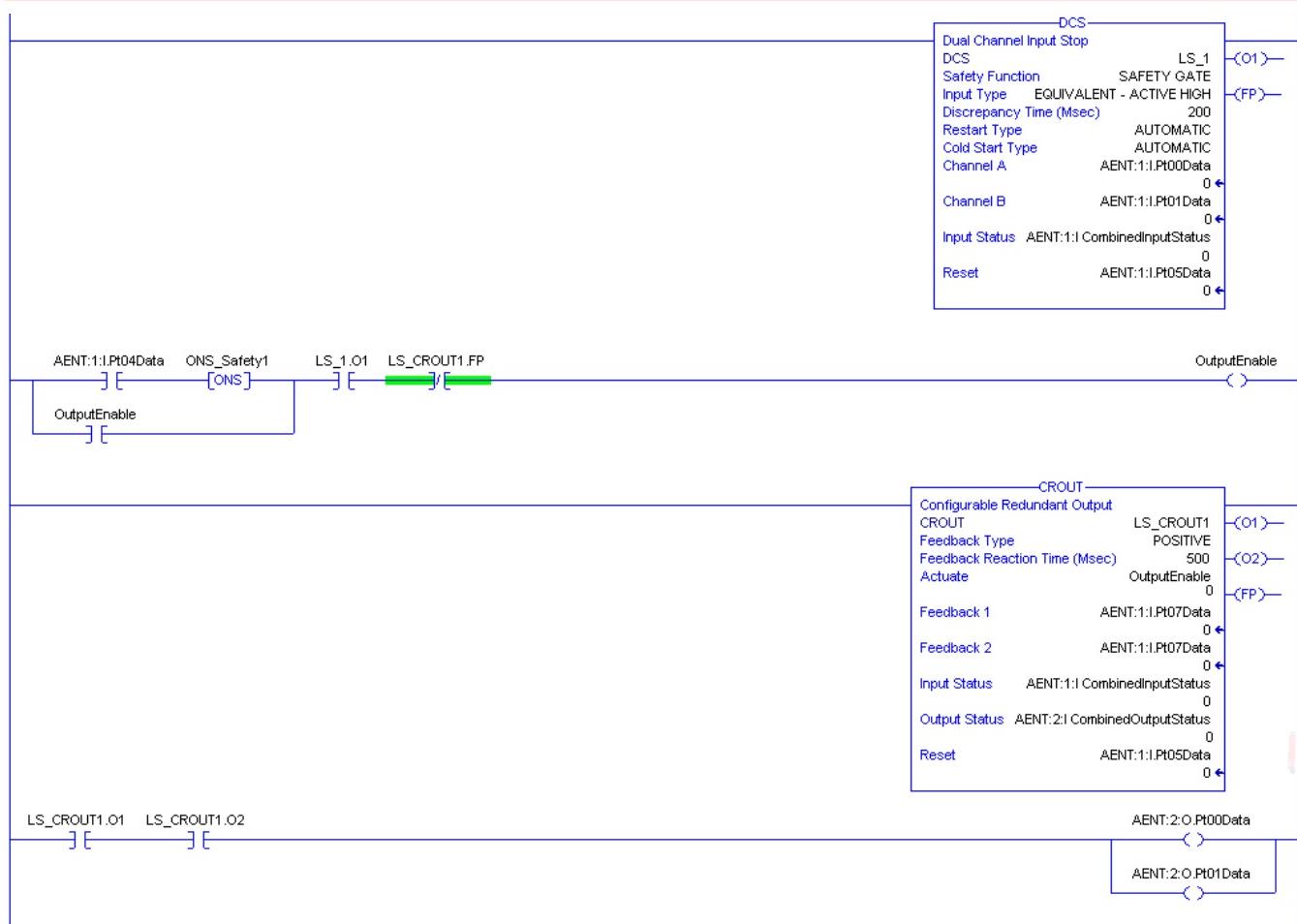
Input Status typically represents the channel status of the two input channels. In this example, the Combined Input Status bit goes low (0) if any of the eight input channels has a fault.

In this example, the DCS reset acts as a fault reset. Even when configured for automatic restart, a reset is required to recover from a fault.

The output (O1) of the DCS is used as a safety interlock in the seal-in rung to drive the output enable tag. If the DCS output drops out, so does the output enable, and it remains off until a manual reset action is carried out.

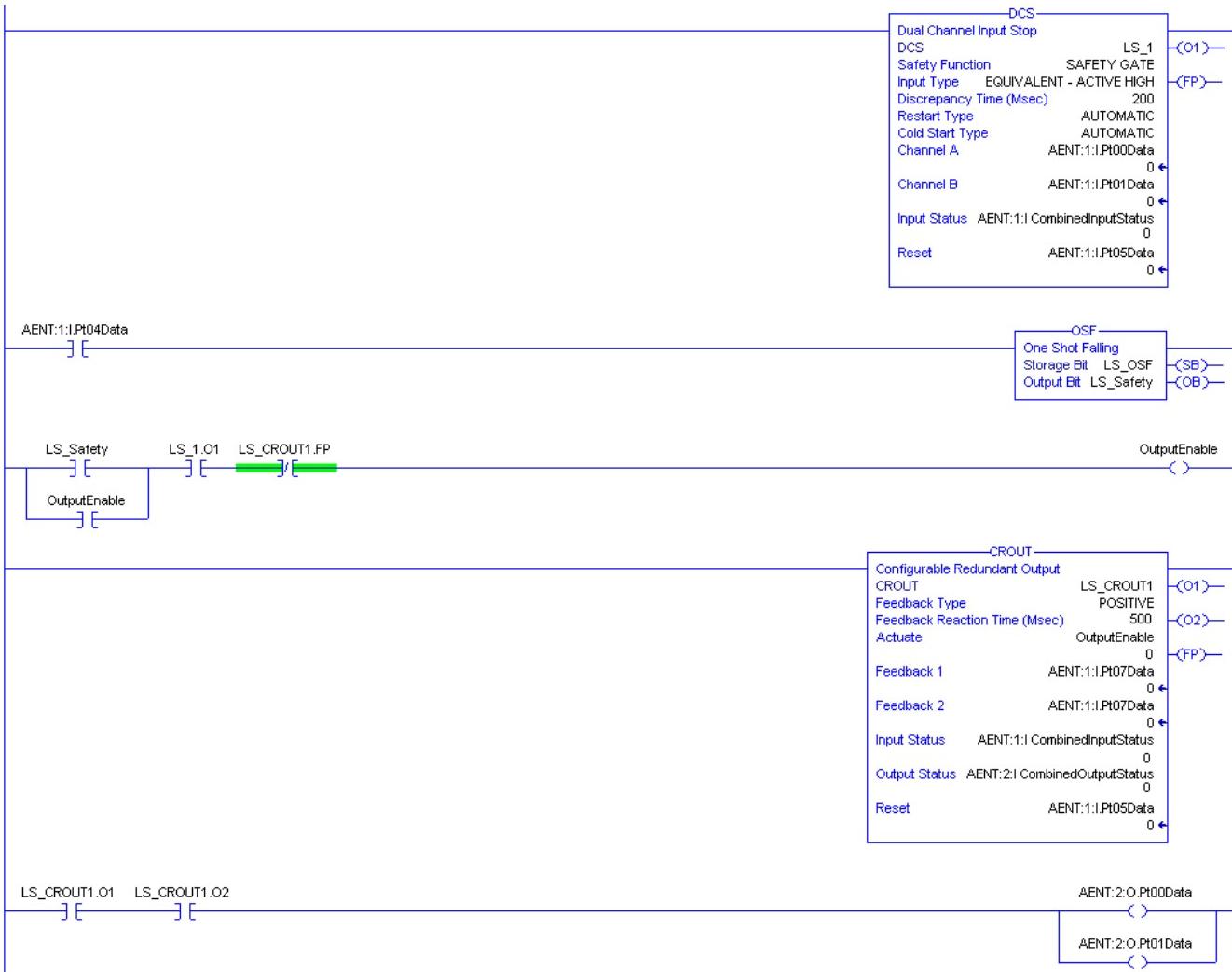
The Configurable Redundant Output (CROUT) instruction controls and monitors redundant outputs. Essentially, this instruction verifies that feedback follows the safety outputs appropriately. For the negative feedback used in this example, if the outputs are high (1), the feedback is low (0) and vice versa. In this example, the feedback has 500 ms to change to the proper state. Because only a single feedback circuit is being used, the feedback tag is used for both Feedback 1 and 2.

The two output tags from the CROUT instruction are used to drive the contactor outputs on the 1734-OB8S module.



Falling Edge Reset

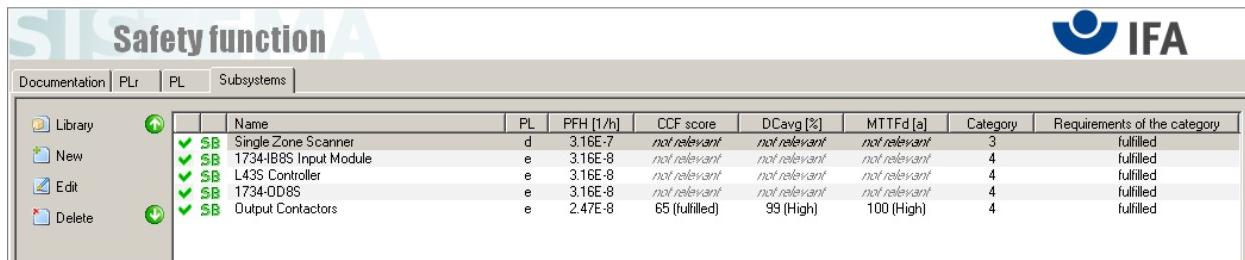
ISO 13849-1 stipulates that instruction reset functions must occur on falling edge signals. To comply with this requirement, add a One Shot Falling (OSF) instruction to the rung immediately preceding the OutputEnable rung, then use the OSF instruction Output Bit tag as the reset bit for the following rung. The OutputEnable is still used to enable the CROUT instruction. The modified code appears below in rungs 1 and 2.



Calculation of the Performance Level

When properly implemented, the SafeZone laser scanner safety function can achieve a safety rating of Category 3, Performance Level d (CAT. 3, PLd), according to EN ISO 13849-1: 2008, as calculated using the SISTEMA Software PL Calculation Tool.

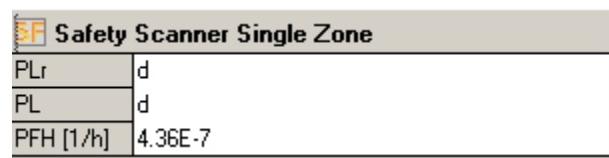
The individual subsystem values are shown below.



The screenshot shows a software interface for calculating safety functions. At the top, there are tabs for Documentation, PLr, PL, and Subsystems. On the left, there are buttons for Library, New, Edit, and Delete. The main area displays a table of subsystems with their names, performance levels (PL), failure rates (PFH), CCF scores, DCavg percentages, MTTFd values, categories, and fulfillment status. The subsystems listed are:

Name	PL	PFH [1/h]	CCF score	DCavg [%]	MTTFd [a]	Category	Requirements of the category
Single Zone Scanner	d	3.16E-7	not relevant	not relevant	not relevant	3	fulfilled
1734-IB8S Input Module	e	3.16E-8	not relevant	not relevant	not relevant	4	fulfilled
L43S Controller	e	3.16E-8	not relevant	not relevant	not relevant	4	fulfilled
1734-OB8S	e	3.16E-8	not relevant	not relevant	not relevant	4	fulfilled
Output Contactors	e	2.47E-8	65 (fulfilled)	99 (High)	100 (High)	4	fulfilled

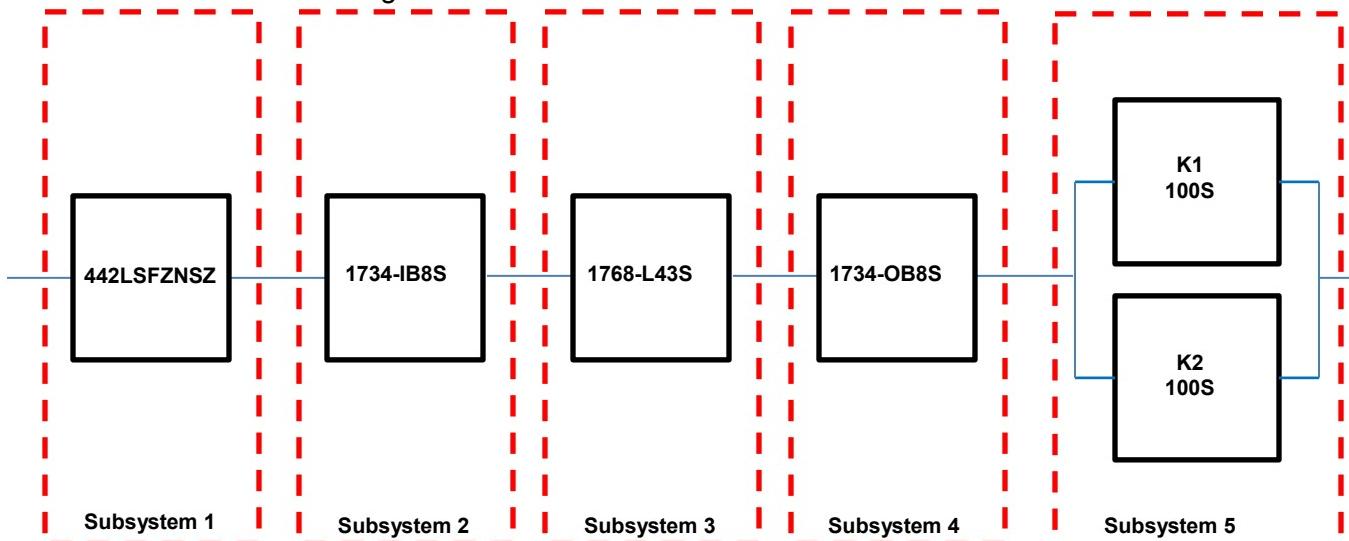
The overall Safety function value is shown below.



The screenshot shows a summary table for the "Safety Scanner Single Zone". It includes fields for PLr (d), PL (d), and PFH [1/h] (4.36E-7).

Safety Scanner Single Zone	
PLr	d
PL	d
PFH [1/h]	4.36E-7

The laser scanner safety function can be modeled as shown in the following safety block diagram.



Calculations are based on one operation of the scanner per hour; therefore, 8760 operations of the contactor per year.

The measures against Common Cause Failure (CCF) are quantified by using the scoring process outlined in Annex F of EN ISO 13849-1. For the purposes of the Performance Level calculation, the required score of 65, needed to fulfill the CCF requirement, is considered to be met.

The complete CCF scoring process must be performed when implementing this example.

SB Single Zone Scanner	
PL	d
PFH [1/h]	3.16E-7
Cat.	3
MTTFd [a]	<i>not relevant</i>
DCavg [%]	<i>not relevant</i>
CCF	<i>not relevant</i>

SB 1734-IB8S Input Module	
PL	e
PFH [1/h]	3.16E-8
Cat.	4
MTTFd [a]	<i>not relevant</i>
DCavg [%]	<i>not relevant</i>
CCF	<i>not relevant</i>

SB L43S Controller	
PL	e
PFH [1/h]	3.16E-8
Cat.	4
MTTFd [a]	<i>not relevant</i>
DCavg [%]	<i>not relevant</i>
CCF	<i>not relevant</i>

SB 1734-OD8S	
PL	e
PFH [1/h]	3.16E-8
Cat.	4
MTTFd [a]	<i>not relevant</i>
DCavg [%]	<i>not relevant</i>
CCF	<i>not relevant</i>

SB Output Contactors	
PL	e
PFH [1/h]	2.47E-8
Cat.	4
MTTFd [a]	100 (High)
DCavg [%]	99 (High)
CCF	65 (fulfilled)

Because these are electro-mechanical devices, the safety contactors data includes the following:

- Mean Time to Failure, dangerous (MTTFd)
- Diagnostic Coverage (DCavg)
- Common Cause Failure (CCF)

Electro-mechanical devices' functional safety evaluations include the following:

- How frequently they are operated
- Whether they are effectively monitored for faults
- Whether they are properly specified and installed

SISTEMA software calculates the MTTFd by using B10d data provided for the contactors along with the estimated frequency of use, entered during the creation of the SISTEMA project.

The DCavg (99%) for the contactors is selected from the Output Device table of EN ISO 13849-1 Annex E, Direct Monitoring.

The CCF value is generated by using the scoring process outlined in Annex F of EN ISO 13849-1. The complete CCF scoring process must be performed when actually implementing an application. A minimum score of 65 must be achieved.

Verification and Validation Plan

Verification and validation play important roles in the avoidance of faults throughout the safety system design and development process. EN ISO 13849-2 sets the requirements for verification and validation. The standard calls for a documented plan to confirm all of the safety functional requirements have been met.

Verification is an analysis of the resulting safety control system. The Performance Level (PL) of the safety control system is calculated to confirm that the system meets the required Performance Level (PLr) specified. The SISTEMA software is typically used to perform the calculations and assist with satisfying the requirements of EN ISO 13849-1.

Validation is a functional test of the safety control system to demonstrate that the system meets the specified requirements of the safety function. The safety control system is tested to confirm that all of the safety-related outputs respond appropriately to their corresponding safety-related inputs. The functional test includes normal operating conditions in addition to potential fault injection of failure modes. A checklist is typically used to document the validation of the safety control system.

Validation of software development is the process in which similar methodologies and techniques that are used in hardware development are deployed. Faults created through poor software development processes and procedures are systemic in nature rather than faults associated with hardware, which are considered as random.

Prior to validating the GuardLogix Safety System, it is necessary to confirm that the safety system and safety application program have been designed in accordance with the GuardLogix System Safety Reference Manuals, publication [1756-RM093](#) (GuardLogix 5560 and Compact GuardLogix controllers) and [1756-RM099](#) (GuardLogix 5570 controllers), and the GuardLogix Application Instruction Safety Reference Manual, publication ([1756-RM095](#)).

GuardLogix Laser Scanner Control Safety Function			
General Machine Information			
Machine Name/Model Number			
Customer Name			
Test Date			
Tester Name(s)			
Schematic Drawing Number			
Controller Name			
Safety Signature ID			
Safety Network Number(s)			
RSLogix 5000 Software Version			
Safety Control System Modules	GuardLogix Modules	Firmware Revision	
GuardLogix Safety Controller	1768-L43S		
CompactLogix Ethernet Bridge	1768-ENBT		
POINT I/O™ Ethernet Adapter	1734-AENT		
POINT I/O Input Modules	1734-IB8S		
POINT I/O Output Modules	1734-OB8S		
GuardLogix Safety System Configuration and Wiring Verification			
Test Step	Verification	Pass/Fail	Changes/Modifications
	Verify that safety system has been designed in accordance with the GuardLogix System Safety Reference Manuals listed in the Additional Resources .		
	Verify that safety application program has been designed in accordance with the GuardLogix Application Instruction Safety Reference Manual, publication 1756-RM095 .		
	Visually inspect the safety system network and I/O modules to verify that they are wired as documented in the schematics.		
	Visually inspect the SafeZone laser scanner to verify that it is wired as documented.		
	Visually inspect the RSLogix 5000 program to verify that safety systems network and I/O module configuration are configured as documented.		
	Visually inspect the RSLogix 5000 application program to verify that suitable safety-certified instructions are utilized and the logic is readable, understandable, and testable with the aid of clear comments.		
	All input devices are qualified by cycling their respective actuators. Monitor the status in the RSLogix 5000 controller tags window.		
	All of the output devices are qualified by cycling their respective actuators. Monitor the status in the RSLogix 5000 controller tags window.		

GuardLogix Laser Scanner Control Safety Function (continued)			
Normal Operation Verification - The GuardLogix safety system properly responds to all normal Start, Stop, Scanner Input, and Reset commands.			
Test Step	Verification	Pass/Fail	Changes/Modifications
	Initiate a Start command. Both contactors energize for a normal machine Run condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
	Initiate a Stop command. Both contactors de-energize for a normal machine Stop condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
	While the system is running, interrupt the SafeZone laser scanner. Both contactors de-energize and open for a normal safe condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
	While the system is stopped, interrupt SafeZone laser scanner and initiate a Start command. Both contactors remain de-energized and open for a normal safe condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
	Initiate a Reset command. Both contactors remain de-energized. Verify proper machine status indication and RSLogix 5000 safety application program indication.		

GuardLogix Laser Scanner Control Safety Function (continued)			
Abnormal Operation Validation - The safety system properly responds to all foreseeable faults with corresponding diagnostics.			
SafeZone Laser Scanner Control Safety Input tests			
Test Step	Validation	Pass/Fail	Changes/Modifications
	While the system is running, remove the channel 1 wire from the safety I/O module. Both contactors de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify that the system is unable to reset and restart with fault. Restore channel 1 and repeat for channel 2.		
	While the system is running, short the channel 1 of the safety I/O module to 24V DC. Both contactors de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Repeat for channel 2. Verify that the system is unable to reset and restart with fault. Restore channel 1 and repeat for channel 2.		
	While the system is running, short the channel 1 of the safety I/O module to 0V DC. Both contactors de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Repeat for channel 2. Verify that the system is unable to reset and restart with fault. Restore channel 1 and repeat for channel 2.		
	While the system is running, short channels 1 and 2 of the safety I/O module. Both contactors de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify that the system is unable to reset and restart with fault. Restore channel 1 and channel 2 wiring.		
GuardLogix Control and Network Tests			
Test Step	Verification and Validation	Pass/Fail	Changes/Modifications
	While the system is running, remove the Ethernet network connection between the safety I/O module and the controller. All contactors de-energize. Verify proper machine status indication and I/O connection status in the RSLogix 5000 safety application program.		
	Restore the Safety I/O module network connection and allow time to re-establish communication. Verify the value of the connection status bit in the RSLogix 5000 safety application program.		
	While the system is running, switch the controller out of Run mode. All contactors de-energize. Return the keyswitch back to Run mode. All contactors remain de-energized. Verify proper machine status indication and RSLogix 5000 safety application program indication.		

GuardLogix Laser Scanner Control Safety Function (continued)			
Safety Contactor Output Tests			
Test Step	Verification and Validation	Pass/Fail	Changes/Modifications
	Initiate a Start command. Both contactors energize for a normal machine run condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
	While the system is running, remove the contactor feedback from the safety I/O module. All contactors remain energized. Initiate a Stop command and attempt a Reset command. The system does not restart or reset. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
	While the system is running, short the contactor feedback to the safety I/O module. All contactors remain energized. Initiate a Stop command and attempt a Reset command. The system does not restart or reset. Verify proper machine status indication and RSLogix 5000 safety application program indication.		

Additional Resources

Refer to these publications for more information about related products from Rockwell Automation.

Resource	Description
Compact GuardLogix Controllers User Manual, publication 1768-UM002	Provides information on configuring, operating, and maintaining Compact GuardLogix controllers.
POINT Guard I/O Safety Modules Installation and User Manual, publication 1734-UM013	Provides information on installing, configuring, and operating POINT Guard I/O modules.
GuardLogix Control Systems Safety Reference Manual, publication 1756-RM093	Contains detailed requirements for achieving and maintaining safety ratings with the GuardLogix and Compact GuardLogix controller systems.
GuardLogix Safety Application Instruction Set Reference Manual, publication 1756-RM095	Provides detailed information on the GuardLogix Safety Application Instruction Set.
GuardLogix 5570 Controller Systems Safety Reference Manual, publication 1756-RM099	Contains detailed requirements for achieving and maintaining safety ratings with the GuardLogix 5570 controller system.
Safety Accelerator Toolkit for GuardLogix System Quick Start Guide, publication IASIMP-QS005	Provides a step-by-step guide to using the design, programming, and diagnostic tools in the Safety Accelerator Toolkit.
SafeZone Singlezone & Multizone Safety Laser Scanner User Manual, publication 10000073050, Ver 01	Provides information on installing, configuring, and operating a SafeZone Safety Laser Scanner.
Safety Product Catalog, publication S117-CA001	Data and guidance concerning safety principals, standards component data and application examples.

You can view or download publications at <http://www.rockwellautomation.com/literature>. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

For more information on
Safety Function Capabilities, visit:

discover.rockwellautomation.com/safety

Rockwell Automation, Allen-Bradley, Rockwell Software, GuardLogix, RSLogix, Stratix 2000, Compact GuardLogix, CompactLogix, POINT Guard I/O, POINT I/O, SafeZone, and LISTEN.THINK.SOLVE. are trademarks of Rockwell Automation, Inc. Trademarks not belonging to Rockwell Automation are property of their respective companies.

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444

Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640

Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846